CLAIMS

1. An actuator, including an electric motor having a stator and a rotor, in which said rotor defines a bearing surface having a non-circular profile, and a radially flexible annular sleeve defines a facing bearing surface the arrangement between the facing bearing surfaces being such that said flexible sleeve adopts a non-circular shape complementary to said profile of said bearing surface of said rotor, said flexible sleeve is restrained against rotation and is in toothed meshing engagement with a circular drive ring at at least two contact regions which are equidistantly spaced apart, said drive ring is rotationally engaged with a screw and threaded sleeve assembly, such that rotation of said drive ring drives said screw and sleeve assembly and causes extension or withdrawal of an output portion of said screw and sleeve assembly for actuation, said actuator being operable such that rotation of said rotor causes said flexible sleeve to flex radially at each of said contact regions to generate a rolling wave which causes rotation of said contact regions and of said drive ring, and whereby said drive ring rotates at a reduced rotational velocity as compared to the rotational velocity of said rotor.

2. An actuator according to claim 1, wherein said rotor includes radially outer and inner surfaces and is disposed co-axially within the stator, said rotor further includes a magnetic arrangement on said radially outer surface thereof and said radially inner surface defining said bearing race having an elliptical profile.

3. An actuator according to claim 2, wherein said magnetic arrangement is accommodated by a magnet backing ring which includes a plurality of magnets mounted to said radially outer surface of said rotor.

4. An actuator according to any one of claims 1 to 3, wherein said flexible sleeve includes a collar and said collar defines said facing bearing surface.

5. An actuator according to any one of claims 1 to 4, wherein said toothed meshing engagement is provided by teeth or splines formed on facing surfaces of said flexible sleeve and said drive ring.

6. An actuator according to any one of claims 1 to 5, said screw and sleeve assembly includes an input sleeve and said output portion is an output screw, and wherein said drive ring is arranged for rotation with said input sleeve and said input sleeve is coaxial with said drive ring and with said output screw, said input sleeve being radially inboard of said drive ring and radially outboard of said output screw.

7. An actuator according to claim 6, wherein said drive ring is in toothed meshing engagement with said input sleeve.

8. An actuator according to claim 6 or 7, wherein said input sleeve is restrained against axial movement and said output screw is restrained against rotational movement, so that rotation of said input sleeve results in axial displacement of said output screw.

9. An actuator according to claim 8, wherein said input sleeve includes opposite ends and wherein a first of said ends is toothed meshing engagement with said drive ring and a second of said ends includes a head portion, said head portion having a surface which is arranged in use to face a complementary surface formed on a locating nut, said locating nut limiting axial movement of said input sleeve by engagement of said facing surfaces

10. An actuator according to claim 9, wherein said facing surfaces are inclined.

11. An actuator according to any one of claims 6 to 10, wherein in use, said output screw engages against the rear of a brake pad for displacing said brake pad into engagement with a disc of a disc brake caliper.

12. An actuator according to any one of claims 6 to 10, wherein in use, said output screw engages against a load spreading device which is in engagement with the rear of a brake pad, for displacing said brake pad into engagement with a disc of a disc brake caliper.

13. An actuator according to any one of claims 1 to 5, said screw and sleeve assembly includes an input screw and said output portion is an output sleeve, and wherein said drive ring is connected for rotation with said input screw and said input screw is coaxial with said drive ring and with said output sleeve, said input screw is restrained against axial movement and said input sleeve is restrained against rotational movement, so that rotation of said input screw results in axial displacement of said output sleeve.

14. An actuator according to any one of claims 1 to 13, said screw and sleeve assembly being a ball screw assembly.

15. An actuator according to any one of claims 1 to 14, wherein said bearing surface of said rotor defines a ball bearing race and said bearing surface of said flexible sleeve defines a facing ball bearing race, and balls are disposed between and in rolling contact with said respective ball bearing races.

16. An actuator according to any one of claims 1 to 15, said bearing surface of said rotor has an elliptical profile, such that said flexible sleeve adopts an elliptical shape complementary to said elliptical profile, and wherein said flexible sleeve is in toothed meshing engagement with said drive ring at two contact regions which are diametrically opposed such that said rolling wave is elliptical.

17. An actuator according to any one of claims 1 to 15, said bearing surface of said rotor has a profile such that said flexible sleeve is in toothed meshing engagement with said drive ring at three equidistantly spaced contact regions.

18. An actuator according to any one of claims 1 to 13, wherein said flexible sleeve includes a head portion end which is anchored to restrain said sleeve against rotational movement.

19. An actuator according to claim 18, said head portion being formed remote from said toothed meshing engagement between said flexible sleeve and said drive ring.

20. An actuator according to any one of claims 18 or 19, said head portion depending from said flexible sleeve radially outwardly.

21. An actuator according to any one of claims 18 to 20, said head portion being substantially annular.

22. An actuator according to any one of claims 18 to 21, wherein said head portion is anchored in use between a housing portion of a disc brake caliper and a threaded nut that threadably engages said housing portion.

23. An actuator according to claim 18 when dependent on claim 9, wherein said head portion of said flexible sleeve is adjacent to said head portion of said input sleeve with a bearing interposed between said respective head portions to facilitate relative rotation and reaction of axial loading of said input sleeve to said head portion of said flexible sleeve.

24. An actuator according to any one of claims 1 to 4, said screw and sleeve assembly includes a sleeve which extends about a screw and said sleeve and said screw are coaxial and rotatable relative to each other, wherein interposed between said sleeve and said screw for a portion of the coaxial extent thereof, is a plurality of balls, said sleeve closely overlies said screw for the remaining portion of the coaxial extent and said sleeve extends beyond the axial extent of said screw to define a radially inwardly facing journal surface for sliding engagement with a support which is fixed to and extends from said screw, for supporting said screw relative to said sleeve to restrain movement from coaxial with said sleeve.

25. An actuator according to any one of claims 1 to 24, wherein said toothed meshing engagement is arranged such that the number of teeth of said flexible

sleeve is greater than the number of teeth of said drive ring by an amount divisible by the number of said contact regions.

26. An actuator according to any one of claims 1 to 25, said actuator being a brake assembly actuator.

27. A disc brake caliper including an actuator according to any proceeding claim.

28. A disc brake caliper including a housing arranged to straddle a rotor disc and an anchor bracket for attaching the caliper to a vehicle, the housing supporting a pair of brake pads on opposite sides of the disc and displacement of a first of the brake pads into engagement with one side of the disc causes said housing to shift relative to said anchor bracket to bring the second of said brake pads into engagement with a second and opposite side of the disc, said housing at least partly accommodating an actuator for displacing said first brake pad into engagement with said disc, said actuator including an electric motor having a stator and a rotor, in which said rotor defines a bearing surface having a non-circular profile, and a radially flexible annular sleeve defines a facing bearing surface the arrangement between the facing bearing surfaces being such that said flexible sleeve adopts a non-circular shape complementary to said profile of said bearing surface of said rotor, said flexible sleeve is restrained against rotation and is in toothed meshing engagement with a circular drive ring at at least two contact regions which are equidistantly spaced apart, said drive ring is rotationally engaged with a screw and threaded sleeve assembly, such that rotation of said drive ring drives said screw and sleeve assembly and causes extension or withdrawal of an output portion of the said ball screw assembly for displacement of said first brake pads, said actuator being operable such that rotation of said rotor causes said flexible sleeve to flex radially at each of said contact regions to generate a rolling wave which causes rotation of said contact regions and of said drive ring, and whereby said drive ring rotates at a reduced rotational velocity as compared to the rotational velocity of said rotor.

29. A disc brake caliper according to claim 28, said stator being fixed to said housing radially outwardly of said rotor.

30. . A disc brake caliper according to claim 28 or 29, said housing including a removable cover that extends about an end section of said housing, removal of said cover allowing access to said actuator.